50X1-HUM

Title: ANGULAR DISTRIBUTION OF NEUTRONS WITH ENERGY AROUND 0.2 MeV DURING SCATTERING BY PROTONS (USSR) (T. A. Golobordko)

Source: Zhur Eksper i Teoret Fiz, Vol 17, No 10, pp 945-6, 1947

Declassified in Part - Sanitized Copy Approved for Release 2012/05/04 : CIA-RDP82-00039R000100130026-9

ANGULAR DISTRIBUTION OF NEUTRONS WITH ENERGY AROUND 0.2 MeV DURING SCATTERING BY PROTONS.

By T. A. Golebored'ke.

Inst Phys Ukrainian Acad Sci.

The angular distribution of neutrons scattered by protons was studied by the method of ring-shaped scatterers of paraffin. The source of neutrons was the reaction (Ra, Be) (200 mg of radium mixed with beryllium). Rhodium surrounded by a paraffin sphere of 4.5 cm in diameter was used as detector. The activity of the detector was measured by a Geiger-Mueller counter. Due to the small quantity of paraffin surrounding the detector, only those neutrons were slowed to thermal and resonant energies, which had a low initial energy and which as it is known are present in the starting part of the reaction spectrum. (Ra, Be). By means of comparative measurements of cross sections of scattering of various elements carried out with these neutrons and with photoneutrons of the same energy we succeeded in establishing that in the starting part of the neutron spectrum (Ra, Be) the homogeneous group of neutrons of an energy around 0.2 MeV predominates. This is the reason for ascribing the results, obtained during the study of angular distribution of neutrons at scattering by protons, mainly to neutrons of this group.

The measurement results are presented in table 1 in the form of ratios of neutron intensity in presence of ring-shaped scatterer (I) to the same intensity without scatterer (I_0). Therefrom it follows that the angular distribution of neutrons with energy around 0.2 MeV first, strongly deviates from spherically symmetrical pattern in a system of coordinates with a center in the center of gravity of the system neutron-proton (central system), secondly, in the laboratory system of coordinates a clear scattering under angles $\varphi > 90^\circ$ is observed.

TABLE I

Angular Distribution of Neutrons of Energy of 0.2 MeV in the Laboratory System of Coordinates.

Angle of Scattering φ	I/I_0
$25^\circ \pm 12^\circ$	1.55 ± 0.06
$45^\circ \pm 12^\circ$	1.05 ± 0.05
$68^\circ \pm 12^\circ$	1.46 ± 0.06
$90^\circ \pm 13^\circ$	1.11 ± 0.05
$113^\circ \pm 13^\circ$	1.46 ± 0.05
$135^\circ \pm 13^\circ$	1.02 ± 0.03
$155^\circ \pm 13^\circ$	1.45 ± 0.04

In order to clarify the last effect a series of checking experiments were undertaken. 1) for all scattering angles presented in table 1 φ the scattering by carbon was measured and corresponding corrections were introduced into results obtained at scattering by paraffin, 2) the possibility of multiple scattering of neutrons was investigated, 3) the neutron background was taken under consideration; 4) effects of "backwards" and "forwards" were thoroughly compared in the laboratory system of coordinates; 5) the effect of thermal neutrons, formed in the ring shaped scatterer itself, was investigated; 6) the angular distribution of neutrons of energy exceeding 0.2 MeV was investigated. The results of these verifying measurements led to the conclusion that it is impossible to explain the effect by some systematic error, and that the distribution of neutrons with energy exceeding 0.2 MeV was found to be spherically symmetrical in the central system of coordinates, and within the limits of statistical errors, the scattering under angles φ 90° in the laboratory system of coordinates did not differ from sere.

We conclude from these data that the angular distribution of neutrons of energy 0.2 MeV, or approximately this value, strongly deviates from spherical symmetry in the central system of coordinates. In the laboratory system of coordinates two maxima are observed: at φ 25° and φ 68°, and a minimum at φ 45°. These results agree with data by Curie [1], Harkins et al [2] and Monod-Herzen [3], who observed those anomalies, although less clearly than it was done in our work. The angular distribution of neutrons of energy exceeding 0.2 MeV is spherically symmetrical in the central system of coordinates and agrees with data by Dee and Gilbert [4] and by other investigators [5].

The found angular distribution of neutrons does not agree with the representation of the deuteron energy in the form of a narrow and deep rectangular potential well, but it does not contradict the suggestion of such well with a shallow and wide edge, as introduced by Share and Stein [6] and Mamasachlisov [7]. The radius of action of nuclear forces of the deuteron can be extended to $r - 20.10^{-13}$ cm.

The scattering of neutrons under angles of $\varphi > 90°$ in the laboratory system of coordinates indicates an inellastic interaction of neutron and proton and appears to be a new and inexpected phenomenon. Its interpretation seems at the present time not clear. We hope to publish in a short time detailed data of all measurements.

BIBLIOGRAPHY

[1] F. W. D. Curie. Phys. Rev., 43,672,1933; 44,463,1933.

[2] W. D. Harkins et al. Phys. Rev. 47, 511, 1936;50.980,1936.

[3] P. Auger et G. Monod-Herson. Journ. de Phys., 5,96,1934.

[4] P. J. Dee and C. W. Gilbert. Proc.Roy. Soc. A., 163,265,1937.

[5] T. W. Bonner. Phys. Rev. 52,685,1937; P. G . Kruger et al Phys. Rev. 52,678,1937.

[6] S. S. Share and J. R. Stein. Phys. Rev., 52,48,1937.

[7] V. J. Mamasachlisov. Phys. ZS.d.Sowjetun., 9,198,1936.